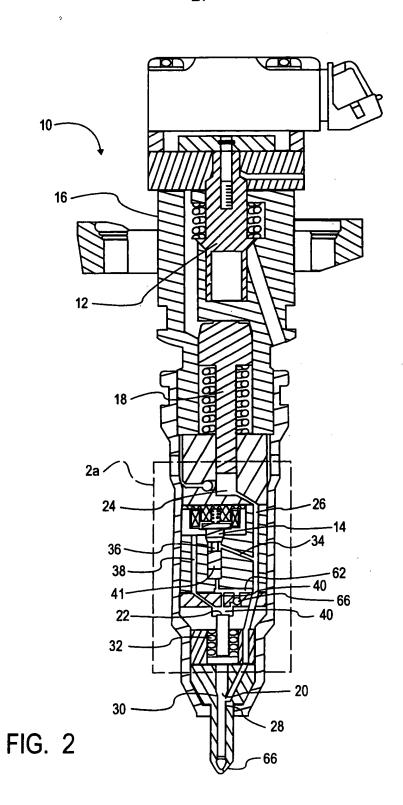


FIG. 1 PRIOR ART



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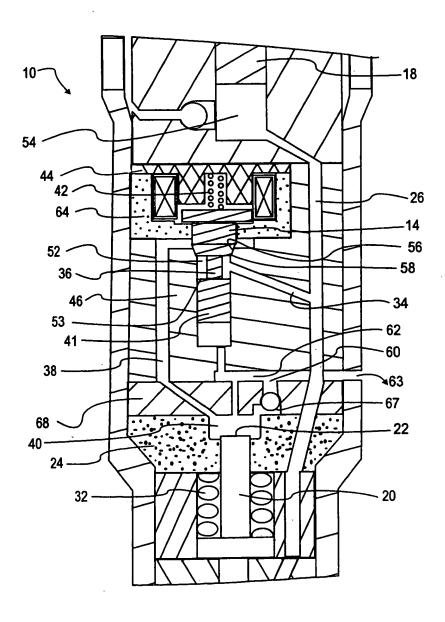


FIG. 2a

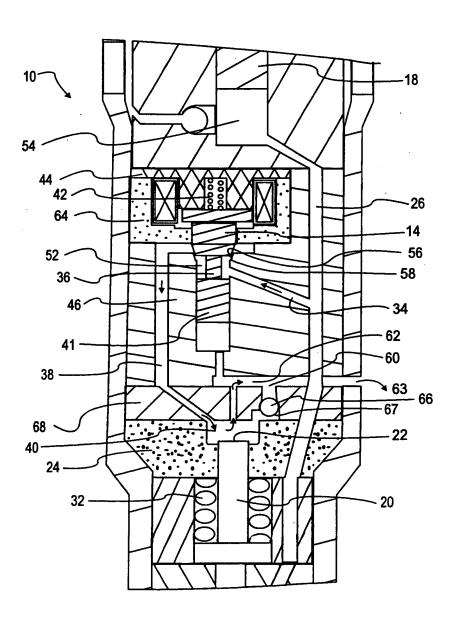
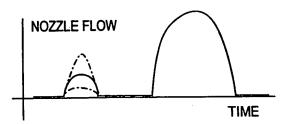


FIG. 2b

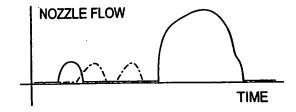
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FIG. 3

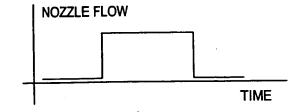
CASE 1



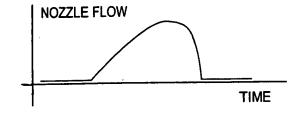
CASE 2



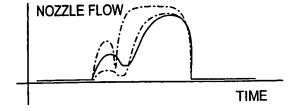
CASE 3



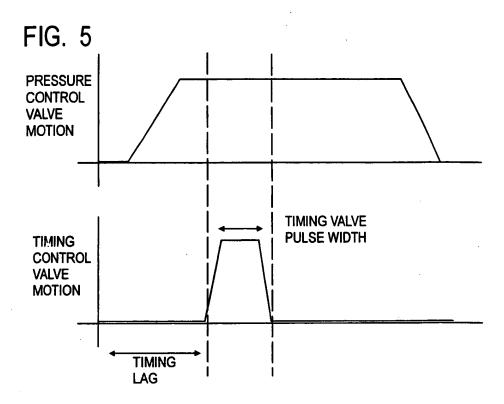
CASE 4

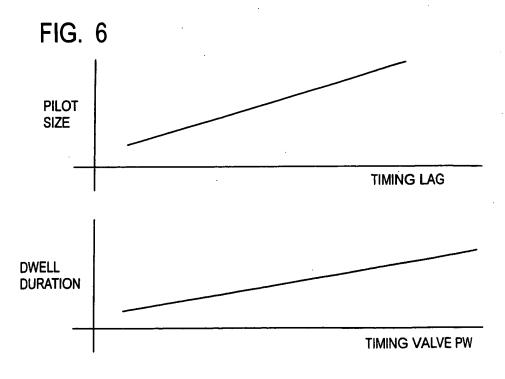


CASE 5



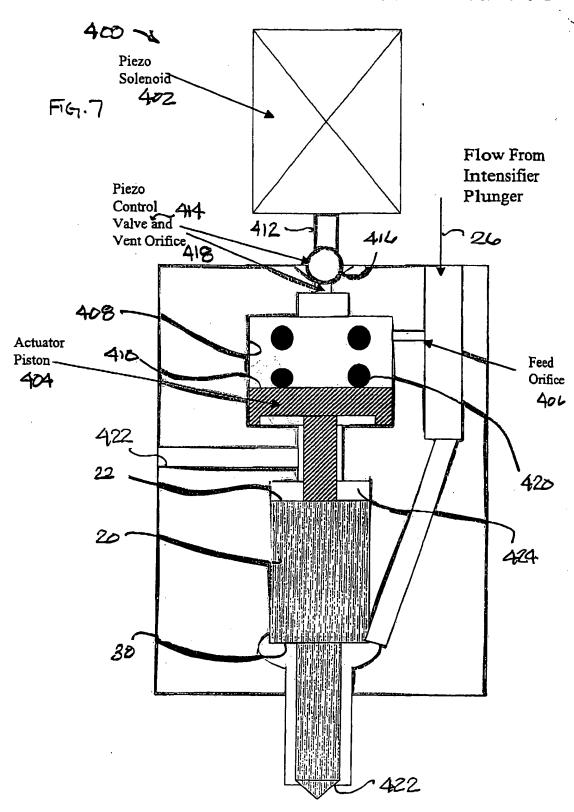
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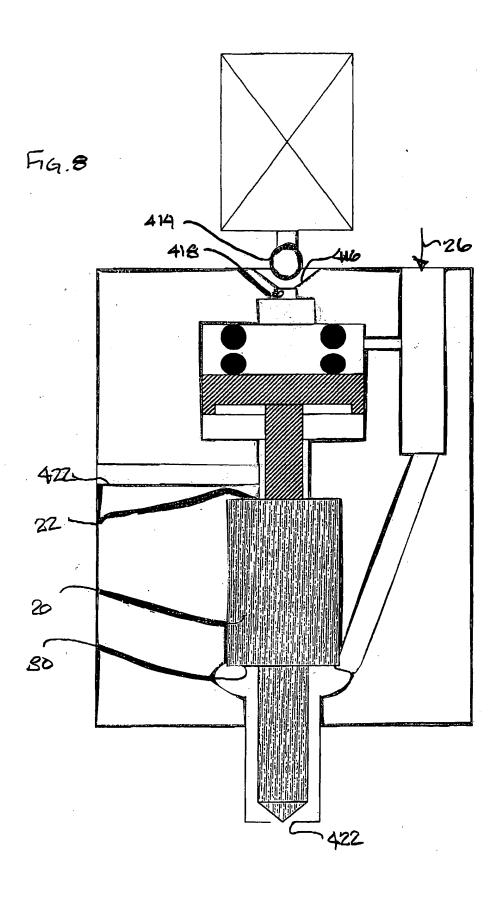




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Piezo Controlled Direct Needle Actuation





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U.S. Patent

Jun. 22, 1999

Sheet 1 of 3

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